

Department of Transportation

D I R E C T I V E

D 22-22

Effective Date:

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Assistant Secretary for Highways

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**Noise Evaluation Procedures for Existing State Highways**

**I. Introduction**

**A. Purpose**

This directive sets forth guidelines to conduct a noise inventory for existing state highways and establishment of noise priority sites.

**B. Supersession**

D 22-22, "Noise Evaluation Procedures for Existing State Highways," dated January 17, 1975.

**C. References**

1. "FHWA Federal-Aid Highway Program Manual", Vol. 7, Chapter 7, Section 3 "Procedures for Abatement of Highway Traffic Noise and Construction Noise," August 9, 1982.
2. IDC, August 26, 1983, **Position Paper** "Criteria for Programming of Noise Attenuation Work" from Tom McLain to District Administrators.

**II. Rules**

- A. Part 8 of FAHPM 7-7-3 promulgates rules for noise abatement on Type II projects (existing highways) with federal-aid participation the same as the federal-aid system on which the project is located.
- B. The priority listing is developed based on an inventory of noise sensitive developments which existed, or for which a building permit had been approved, prior to May 14, 1976.
- C. Department program, budget, and fiscal procedures apply to any noise abatement project which may be constructed from the noise inventory and priority listing.

- D. The steps in Section III, **Procedures**, are used to determine the noise sensitive developments that have the highest priority.
- E. The department's priority listing is current as of August 19, 1986. (See Appendix A.) When new sites must be investigated, because of citizen complaints or public official's concerns, the procedures in this Directive will be used to prioritize those new sites.

### III. **Procedures**

- A. Because the priorities are part of the public record, an accurate administrative record is kept identifying the steps taken to establish the final priority number of each site.

Special care must be taken to identify those elements not included in the priority listing, and why they were not, for administrative review and use in support of the department's actions.

#### B. **Noise Inventory, Prioritization Procedures, and Site Identification**

1. Conduct initial traffic noise evaluation to eliminate highway sections where traffic is insufficient to create an  $Leq = 67$  dBA at the assumed right of way or actual right of way. This can be done in the office.
  - a. Use "Annual Traffic Report" data or **available** special traffic studies.
  - b. Predict noise levels based on FHWA — RD-77-108 "FHWA Highway Traffic Noise Prediction Model."
  - c. Use posted traffic speed.
  - d. Minimize on-site investigations at this stage.
2. Coordinate highway sections potentially having excessive noise with adjacent residential property or special sites.
  - a. Eliminate all highway sections without adjacent residential or special sites or without **physically** practical solutions.
  - b. Eliminate areas where roadside development, including access driveways, preclude noise abatement measures.
3. Continue inventory procedure with expanded emphasis upon developed areas with potentially excessive noise.
  - a. Using the FHWA RD-77-108 model, plot contour of  $Leq = 67$  dBA on statewide arterial route maps or other suitable maps where appropriate developments exist.

- b. Segregate impacted residential areas into workable units for subsequent analysis.
- 4. Conduct on-site inspection as preparation for second phase of prediction.
  - a. Eliminate sites where terrain will minimize a noise impact to less than an  $Leq = 67$  dBA or prohibits feasible abatement measures such as a housing development on a steep slope above the highway.
  - b. Secure criteria of design concepts for abatement (barrier wall, earth berm, etc.).
  - c. Measure noise to confirm original predictions.
- 5. Prepare fully-documented analysis of impacted work units.
  - a. Apply second analysis of work unit areas (to secure **documented**  $Leq$  dBA level for “Before Impact Factor”). See Section IV.
  - b. Include abatement design concepts in analysis for “After Impact Factor.”
  - c. Develop cost estimates for abatement treatment.
  - d. Plot noise contours based upon the most cost-effective attenuation method and inventory residences within work units.
  - e. Complete the Benefit Cost Computations of Section IV and arrange the work units in resultant numerical priority sequence.
- 6. Submit the priority listing to the Office of Project Development for approval.

#### IV. Computation Procedures of Noise Priority Numbers

##### A. Noise Impact

The noise impact for a given group exposed to the same noise level  $Leq$  is

$$\text{Group Impact} = N \times \text{U.F.} \times 2^{\left(\frac{Leq - L_{ref}}{10}\right)}, \text{ where } \left(\frac{Leq - L_{ref}}{10}\right)$$

is a power of 2.

where  $N$  is the number of people in a given group exposed to a noise level of  $Leq$ , U.F. is the usage factor for the site, and  $L_{ref}$  is the appropriate “Noise Abatement Criteria” for the land use of the site as provided in Table 1 FAHPM 7-7-3.

Group impact is computed for each group and added together for each site to give the site impact. This is done for the site both before and after abatement assumptions. The difference is called **benefit**.

## B. Priority Number

1. Obtain the benefit for each site.
2. Estimate the cost of noise barriers for each site. Benefit divided by cost in \$1,000s is the priority number.

## C. User Numbers

1. **Residential.** Based on statistics of Washington State obtained by the Office of Fiscal Management in 1980, the average number of occupants in a single family home is three per house and two per apartment or mobile home.
2. **Special Sites.** The user number for schools, parks, churches, hospitals, etc., is the estimate of the number of users.

## D. Usage Factors

Established usage factors are shown below.

Site	Hours/ Day	Days/ Week	Months/ Year	Usage Factor
Homes	24	7	12	1
Apartments and Mobile Homes	24	7	12	1
Hospitals	24	7	12	1
Churches	6	3	12	.11
Schools	10	5	9	.22
Parks	10	7	5	.17

Factors for other special sites shall be submitted for approval.

## E. Example Computations for Noise Barrier Priority Numbers:

## 1. Residential neighborhood

Assume that before abatement treatment there are four homes exposed to an Leq noise level of 65 dBA, ten homes at 67 dBA, and three homes at 69 dBA. Since the usage factor is one, the average number of people per home is three, and the noise abatement criteria for residential land use is 67 dBA, the computation is as follows:

$$12 \times 2 \left( \frac{(65 - 67)}{10} \right) + 30 \times 2 \left( \frac{(67 - 67)}{10} \right) + 9 \times 2 \left( \frac{(69 - 67)}{10} \right)$$

$$= 12 \times .870 + 30 \times 1 + 9 \times 1.149 = 50.78$$

This is the “Before” impact. Assume that after construction of a noise barrier there are eight homes at 63 dBA, six homes at 60 dBA, and three homes at 67 dBA. The “After” impact is as follows:

$$24 \times 2 \left( \frac{63 - 67}{10} \right) + 18 \times 2 \left( \frac{60 - 67}{10} \right) = 9 \times 2 \left( \frac{67 - 67}{10} \right)$$

$$= 24 \times .758 + 18 \times .615 + 9 \times 1 = 38.26$$

This is the “After” impact. With an estimated noise barrier cost of \$102,000, the priority number of this site is:

$$\frac{50.78 - 38.26}{102} = \frac{12.51}{102} = .123$$

2. Church

Assume 100 members and the church is exposed to 68 dBA before noise walls have been constructed. Since the usage factor is .11 for a church and the noise abatement criteria is 67 dBA, the computation is as follows:

$$100 \times .11 \times 2 \left( \frac{68 - 67}{10} \right) = 11 \times 1.072$$

$$= 11.8$$

This is the “Before” impact. Assume that the noise reduced the exposure to 57 dBA. The “After” impact is as follows:

$$100 \times .11 \times 2 \left( \frac{57 - 67}{10} \right) = 11 \times 5$$

With an estimated noise barrier cost of \$20,000, the priority number is:

$$\frac{11.8 - 5.50}{20} = .315$$

**Appendix 1**  
**Type II Noise Barrier**  
**Priority Listing**

<b>No.</b>	<b>District</b>	<b>Route</b>	<b>MP</b>	<b>Priority</b>
1	3	512	2.0	.79
2	3	5	124.1	.68
3	5	12	288.0	.61
4	3	5	112.3	.57
5	1	99	36.6	.53
6	1	5	175.8	.52
7	1	5	226.1	.48
8	1	5	174.8	.47
9	5	12	282.7	.47
10	5	12	287.4	.46
11	1	405	1.5	.42
12	1	5	173.0	.41
13	1	5	191.1	.40
14	1	169	23.7	.40
15	1	5	194.3	.39
16	1	5	173.4	.38
17	1	169	24.2	.38
18	1	5	230.7	.37
19	1	5	173.5	.37
20	1	5	173.9	.36
21	1	5	252.3	.36
22	2	17	57.1	.35
23	2	2	120.6	.34
24	1	908	4.9	.34
25	1	5	202.4	.34
26	4	5	4.7	.32
27	1	5	145.5	.31
28	2	17	53.2	.31